EXHIBIT 4

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Polymer Science & Materials Chemistry

Expert Report of Maureen T.F. Reitman, Sc.D.

Hardwick v. 3M et al.

Exponent®

Expert Report of Dr. Maureen T.F. Reitman, Sc.D.

Hardwick v. 3M et al.

Prepared for Counsel for

3M Company,
E. I. du Pont De Nemours and Company,
The Chemours Company,
Archroma Management LLC,
Arkema, Inc., Arkema France, S.A.,
AGC Chemicals Americas, Inc.,
Daikin Industries LTD., Daikin America, Inc.,
and Solvay Specialty Polymers, USA, LLC.

Prepared by

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1075 Worcester St
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1. Scope and Limitations

I have been asked by counsel for defendants in the matter of Hardwick v 3M et al. to describe the materials plaintiff has identified as “PFAS” from a chemistry structure/property perspective and explain how the properties that derive from the different structures lead to the selection and use of different PFAS for different end use applications. I have also been asked to describe the complex network of supply associated with the materials plaintiff has identified as “PFAS”, which differs depending on the particular PFAS and use. I have been asked to provide opinions related to these topics and the impact of the structure/property attributes, range of uses, and complex supply network on how “PFAS” may be encountered by individuals.

This report is submitted in the class certification phase of the present matter based on publicly available information, materials cited in this report, and my education, training, and experience. The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. The findings presented herein are made to a reasonable degree of scientific certainty. If new data become available or there are perceived omissions or misstatements in this report, please bring them to my attention as soon as possible so I have the opportunity to fully address them.

2. Qualifications and Professional Experience

I hold two academic degrees: (1) a Bachelor of Science in Materials Science and Engineering from the Massachusetts Institute of Technology (MIT), and (2) a Doctor of Science in Materials Science and Engineering, with a thesis in the field of polymers, from MIT. I have been practicing in the field of polymer science and engineering for more than 25 years, as a researcher at MIT, in a variety of technical roles at the 3M Company, and as a consultant with Exponent, Inc. (Exponent). I am a licensed Professional Engineer in the state of Maryland and a Fellow of the Society of Plastics Engineers.

I am a Principal Engineer and the Group Vice President for Polymers, Materials Chemistry and Biomedical Engineering at Exponent. Founded in 1967, Exponent is a multi-disciplinary engineering and scientific consulting firm that brings together more than 90 different disciplines to solve engineering, science, regulatory, and business issues facing clients such as corporations, insurance carriers, government agencies, law firms and individuals. Exponent is a publicly traded company that employs over 1,000 full-time staff worldwide, including about 800 degreed professionals, more than 500 of whom hold doctorates in their field.

I provide consulting engineering services in all aspects of polymer science and engineering including, but not limited to, material selection, product design and development, mechanical and chemical testing, microscopy and non-destructive imaging, failure analysis, polymer chemistry, polymer physics, and polymer processing. I have experience in evaluation and testing of the physical properties and durability of polymers, in the determination of the formulation and chemistry that control these properties, and in the selection and specification of polymers for different applications. I have experience formulating and evaluating polymer compositions, testing their properties and assessing chemical compatibility. I have been directly involved in product development, product line extensions, transfer of new products to manufacturing, qualification of alternative materials and manufacturing equipment, evaluating customer complaints, and performing root cause investigations. I have lectured on the topics of material selection, plastics failure analysis, and chemically-enhanced failures. I am an active member of two Underwriters Laboratory Standard Technical Panels, STP 746 (Polymeric Materials) and

STP 758 (Appliance Wiring), and the UL task force on Long Term Thermal Aging. My analysis is based on my perspective as a materials scientist, formulator and product development engineer.

My *curriculum vitae* is provided in Appendix A. A list of previous testimony is provided in Appendix B. A list of the materials I have considered is provided in Appendix C. I reserve the right to supplement this report should additional materials become available and I have the opportunity to review them.

In 2020, Exponent charges for my time at a rate of $750/hour. I have been assisted by other Exponent staff with different bill rates. No portion of our compensation is dependent on the outcome of this matter.

Although specific trial exhibits have not been prepared at this time, any and all information referenced in this report may be used. Exponent reserves the right to use animations, demonstratives, enlargements of exhibits, photographs, charts, diagrams, and other devices to illustrate the opinions presented at trial.

3. Introduction

Mr. Hardwick alleges that there is a class of individuals that have been exposed to per- and polyfluoroalkyl substances (PFAS) attributable to the named Defendants in this action. He asserts that this class consists of any individual with 0.05 parts per trillion (ppt) of perfluorooctanoic acid (PFOA) and 0.05 ppt of "any other PFAS" in their blood serum who has lived within the United States for one year or more since 1977.[1] As I describe below, however, there are thousands of known molecules with per- or polyfluorinated segments and these exhibit different properties depending on their chemical structures. Accordingly, "PFAS" may be used in different amounts, proportions, and combinations in different products and processes. These differences are relevant to how "PFAS" may be encountered by an individual. Further, although Mr. Hardwick identifies the named Defendants because they allegedly "marketed, developed, distributed, sold, manufactured, released, trained users, produced instructional materials for, and/or otherwise handled and/or used one or more PFAS materials,"[2] the source and distribution of per- and polyfluorinated chemicals involves a network of production, modification, and formulation that is broader than the named Defendants and limits the reliable identification of sources of "PFAS" in blood serum in the absence of information about an individual's potential exposure.

[1] Plaintiff describes PFAS as "synthetic, toxic per- and polyfluoroalkyl substances, including perfluorooctanoic acid ("PFOA") and perfluorooctane sulfonic acid ("PFOS") and related chemicals, including, but not limited to, those that degrade to PFOA and/or PFOS, and including, but not limited to, C3-C-15 PFAS chemicals, such as perfluorohexanesulfonate (PFHxS), perfluorononanoate (PFNA), perfluorobutanesulfonate (PFBS), perfluorohexanoate (PFHxA), perfluoroheptanoate (PFHpA), perfluoroundecanoate (PFUnA), perfluorododecanoate (PFDoA), HFPA Dimer Acid (CAS #13252-13-6/C3 Dimer Acid/P-08-508/FRD903/GX903/C3DA/GenX), and HFPA Dimer Acid Ammonium Salt (CAS# 62037-80-3/ammonium salt of C3 Dimer Acid/P-08-509/FRD902/GX902/GenX. First Am. Compl., [ECF No. 96] at PageID #561, ¶ 1.

[2] First Am. Compl., [ECF No. 96] at PageID #567, ¶ 29.

4. “PFAS” includes many different types of chemicals that exhibit diverse properties and are used in many different ways

Mr. Hardwick asserts that a class can be clearly defined by a blood test in which PFOA and “any other PFAS” is detected in a person’s blood serum at a concentration of 0.05 ppt or higher and simply asserts that “PFAS” are “synthetic, toxic per- and polyfluoroalkyl substances,” as exemplified by a list of fluorinated substances.[3] He does not define “PFAS” with enough specificity with regards to how, or to what extent, class members encountered the same type and level of per- and polyfluoroalkyl molecules,[4] all of which influence a proposed class member’s potential exposure. Nor can the term “PFAS” be easily defined, as it is an umbrella term that encompasses a wide variety of compositionally different substances. Because the Plaintiff’s definition is not exclusive, in this report I am using the term “PFAS” to indicate any molecule containing a per- or polyfluorinated alkyl segment/group. PFAS can include diverse families of chemistries containing carbon-fluorine bonds that exhibit different physical and chemical properties.[5] As a result, they are used and encountered in different ways, which affects an individual’s potential exposure.

The properties and behaviors of a substance in any particular environment are controlled by, among other things, the chemical structure of the substance, which determines the properties of the pure substance as well as possibilities for interactions with other substances. In other words,

[3] Plaintiff describes PFAS as “synthetic, toxic per- and polyfluoroalkyl substances, including perfluorooctanoic acid (“PFOA”) and perfluorooctane sulfonic acid (“PFOS”) and related chemicals, including, but not limited to, those that degrade to PFOA and/or PFOS, and including, but not limited to, C3-C-15 PFAS chemicals, such as perfluorohexanesulfonate (PFHxS), perfluorononanoate (PFNA), perfluorobutanesulfonate (PFBS), perfluorohexanoate (PFHxA), perfluoroheptanoate (PFHpA), perfluoroundecanoate (PFUnA), perfluorododecanoate (PFDoA), HFPA Dimer Acid (CAS #13252-13-6/C3 Dimer Acid/P-08-508/FRD903/GX903/C3DA/GenX), and HFPA Dimer Acid Ammonium Salt (CAS# 62037-80-3/ammonium salt of C3 Dimer Acid/P-08-509/FRD902/GX902/GenX. First Am. Compl., [ECF No. 96] at PageID #561, ¶ 1.

[4] A “perfluorinated” molecule contains a C-F bond at every location that the related hydrocarbon would otherwise contain a C-H bond, while a “polyfluorinated” alkyl molecule contains C-F bonds but also retains one or more C-H bonds.

[5] For example, Buck, R.C., Franklin, J., Berger, U., Conder, J.M., Cousins, I.T., de Voogt, P., Jensen, A.A., Kannan, K., Mabury, S.A., & van Leeuwen, S.P.J. (2011) *Int. Env. Assess. and Management*, *7*(4), 513-541

the atoms that are present and their relative connectivity and configuration in a molecule determine the types of interactions that the molecule can have with other molecules and materials (e.g., water, human skin, etc.), through either chemical reactions or physical processes.

With respect to PFAS, carbon-fluorine bonds alone do not control the behavior and properties of these substances. While the carbon-fluorine bond may impart common but differentiable characteristics to per- and poly-fluorinated substances,[6] the degree to which these properties and others are exhibited depends on the particular structure. In addition to carbon and fluorine, some PFAS contain other types of atoms, such as oxygen, nitrogen, or sulfur (among others), that impart specific and different chemical reactivity and physical properties that will depend on their number, type, and arrangement.[7] PFAS may differ in other ways as well: they may be molecules of different sizes (small molecules, oligomers, or polymers), substances with different chemical or biological reactivity (chemical functional groups), substances with different degrees of fluorination (per- vs. poly-fluoro), or substances with different polymer architecture (main chain vs. side chain fluorination; linear, branched, and cyclic structure; unsaturation within the polymer chain).[8]

It is unsurprising, given the wide diversity of fluorinated chemicals, their properties, and uses, that there is no generally-recognized definition of the term "PFAS." For example, regulatory

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[6] When per- or poly-fluorinated, an alkyl chain exhibits enhanced stability towards chemical, thermal, and biological decomposition compared to the analogous hydrocarbon; this stability is one of the features for which some PFAS are chosen for use in many applications, and one of the reasons that different types of heteroatoms and functional groups are introduced in molecules intended for use in certain applications. In addition, per and poly-fluorinated species show unique solubility/miscibility behavior in liquid matrices compared to, for example, hydrocarbons, and this is critical for some applications.

[7] Buck, R.C., Franklin, J., Berger, U., Conder, J.M., Cousins, I.T., de Voogt, P., Jensen, A.A., Kannan, K., Mabury, S.A., & van Leeuwen, S.P.J. (2011) *Int. Env. Assess. and Management*, *7*(4), 513-541.

[8] U.S. Environmental Protection Agency (2020) *Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances; Significant New Use Rule* (40 CFR Part 721, Vol. 85, No. 144, pp. 45109-45126); Interstate Technology Regulatory Council. (2020) *Naming Conventions for Per- and Polyfluoroalkyl Substances (PFAS)*; U.S. Environmental Protection Agency (2002) *Perfluoroalkyl Sulfonates; Significant New Use Rule; Final Rule and Supplemental Proposed Rule* (40 CFR Part 721, Vol. 67, No. 47, pp. 11008-11013); Organization for Economic Cooperation and Development. Environment Directorate. (2018) *Toward a New Comprehensive Global Database of Per- and Polyfluoroalkyl Substances (PFASs): Summary Report on Updating the OECD 2007 List of Per- and Polyfluoroalkyl Substances (PFASs)* (Series on Risk Management, No. 39); Henry, B.J., Carlin, J.P., Hammerschmidt, J.A., Buck, R.C., Buxton, L.W., Fiedler, H., Seed, J., & Hernandez, O. (2018) *Int. Env. Assess. and Management*, *14*(3), 316-334.

agencies (e.g., EPA,[9] FDA,[10] CDC,[11] ATSDR,[12] ECHA[13]) and organizations (e.g., ITRC,[14] OECD[15]) have different definitions of the term "PFAS" and include different substances in PFAS databases. ITRC specifically notes that "[t]here is confusion among the environmental community and the public due to overgeneralization when describing PFAS and the lack of consistent naming of specific PFAS."[16] Many agencies and organizations cite or use the conventions set forth in Buck et al. (2011),[17] with some modification, though the formulaic definitions of PFAS that focus on molecular structure often fail to encompass all of the specific PFAS that are recognized by various agencies. Furthermore, all of these definitions are based on chemical structure and are not linked to toxicity under a specific set of conditions.

Indeed, as a result of structural differences, chemical and physical properties of PFAS that may be relevant to an exposure assessment vary widely. Different PFAS can be solid, liquid, or gaseous under ambient conditions (with correspondingly different vapor pressures, melting points, and boiling points, all of which are linked to transport properties),[18] and can have

[9] U.S. EPA, (2020) "PFAS Master List of PFAS Substances (Version 2)", https://comptox.epa.gov/dashboard/chemical_lists/pfasmaster, Accessed December 9, 2020.

[10] U.S. FDA "Inventory of Effective Food Contact Surfaces (FCS) Notifications", https://www.cfsanappsexternal.fda.gov/scripts/fdcc/index.cfm?set=FCN, Accessed December 8, 2020.

[11] U.S. CDC, (2018) "National Health and Nutrition Examination Survey: Perfluoroalkyl and Polyfluoroalkyl Substances", https://wwwn.cdc.gov/Nchs/Nhanes/2017-2018/PFAS_J.htm, Accessed December 8, 2020.

[12] U.S. Agency for Toxic Substances & Disease Registry, "Toxic Substances Portal: Perfluoroalkyls", https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=237, Accessed December 8, 2020.

[13] European Chemicals Agency, "EU REACH Registered Substances", https://echa.europa.eu/information-on-chemicals/registered-substances, Accessed December 8, 2020.

[14] International Regulatory Technology Council "PFAS - Per- and Polyfluoroalkyl Substances." *PFAS Chemistry, Terminology, and Acronyms*, Sept. 2020, https://pfas-1.itrcweb.org/2-2-chemistry-terminology-and-acronyms/. Accessed November 16, 2020.

[15] Organization for Economic Cooperation and Development. Environment Directorate. (2020) *Comprehensive Global Database of PFASs*, http://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/. Accessed December 8, 2020.

[16] International Regulatory Technology Council "PFAS - Per- and Polyfluoroalkyl Substances." *PFAS Chemistry, Terminology, and Acronyms*, Sept. 2020, pfas-1.itrcweb.org/2-2-chemistry-terminology-and-acronyms/. Accessed November 16, 2020.

[17] Buck, R.C., Franklin, J., Berger, U., Conder, J.M., Cousins, I.T., de Voogt, P., Jensen, A.A., Kannan, K., Mabury, S.A., & van Leeuwen, S.P.J. (2011) *Int. Env. Assess. and Management*, *7*(4), 513-541

[18] Smart, B.E. (1994) Characteristics of C-F Systems. In Banks, R. E., Smart, B. E., & Tatlow, J. C., Eds.; *Organofluorine Chemistry* (pp. 57–88). Plenum Press.

different solubility/miscibility in various media like water and oil[19] along with different surface energy/hydrophilic-lipophilic balance (HLB) properties.[20] Further, PFAS compounds have different stability behavior when subjected to conditions such as high temperatures, UV light, and other reactive chemical environments.[21] Complicating the situation further, certain fluorinated substances that are commercially described as a single material may contain a range of related structures that differ in size and molecular organization,[22] while most manufactured products have the potential to contain some artefacts of the production process prior to purification or recycling steps.[23] All of this likewise introduces potential differences in the specific behavior of the nominally pure material.

Looking to Plaintiff's description of PFAS, certain differences based on molecular size and functional groups are already recognizable. As an illustration of this point, two of the substances identified by the Plaintiff as examples, PFHpA and PFHxS, contain the same number of perfluorinated carbons (i.e., a C_6F_{13} segment) but have a different number, type, and arrangement of heteroatoms (i.e., different functional groups).[24] Just this small difference is enough to produce a 100 °C difference in the molecules' boiling points and a difference of eight orders of magnitude in their vapor pressures. These are two properties to consider when attempting to characterize the behavior of these compounds in different contexts.[25] Similarly,

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[19] Rao, N.S., & Baker, B.E. (1994) Textile Finishes and Fluorosurfactants. In Banks, R. E., Smart, B. E., & Tatlow, J. C., Eds.; *Organofluorine Chemistry* (pp. 321–338). Plenum Press.

[20] Rao, N.S., & Baker, B.E. (1994) Textile Finishes and Fluorosurfactants. In Banks, R. E., Smart, B. E., & Tatlow, J. C., Eds.; *Organofluorine Chemistry* (pp. 321–338). Plenum Press.

[21] Xiao, F. Sasi, P.C., Yao, B., Kubatova, A., Golovko, S.A., Golovko, M.Y., Soli, D. (2020) *Environ. Sci. Technol. Lett.*, *7*(5), 343-350; Lazzari, M., Aglietto, M., Castelvetro, V., Chiantore, O. (2001), *Chem. Mater. 13*(9), 2843-2849; Bentel, M.J., Yu, Y., Xu, L., Kwon, H., Li, Z., Wong, B.M., Men, Y., Liu, J., (2020), *Environ. Sci. Technol. 54*(4), 2489-2499.

[22] Alsmeyer, Y. W., Childs, W. V., Flynn, R. M., Moore, G., Smeltzer, J. C. (1994) Electrochemical fluorination and its applications. In Banks, R. E., Smart, B. E., & Tatlow, J. C., Eds.; *Organofluorine Chemistry* (pp. 121–144) Plenum Press.

[23] Texas Instruments (2015) *Comments on proposed Significant New Use Rule for Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances* (Docket No. EPA-HO-OPPT-2013-0225). United States Environmental Protection Agency.

[24] Perfluoroheptanoic acid (PFHpA) has the formula C6F13COOH; Perfluorohexanesulfonic acid (PFHxS) has the formula C6F13SO2OH. *See, e.g.*, pubchem.ncbi.nlm.nih.gov for additional information regarding structure of these compounds.

[25] For example, the mean experimentally measured boiling points of two -C_6F_{13} compounds, PFHpA (146 ºC) and PFHxS (246 ºC) differ by 100 °C (212 °F), while mean experimentally measured vapor pressures differ by

despite having the same functional group, the measured properties for perfluorinated carboxylic acids with different-length fluorinated chains also vary widely. For example, measured water solubility for perfluorinated acids with six, eight or eleven carbons (PFHxA, PFOA, PFUnDA) are 29 mg/L, 5,672 mg/L, 91 mg/L; these are not similar and do not exhibit a consistent trend based on perfluorinated chain length.[26] The differences can be even more profound when other molecules are considered.[27]

In other words, PFAS with different structures exhibit different properties. Many of these properties are relevant to how the compounds interact with other materials and systems, which can affect the potential for exposure. Furthermore, the presence of per-and polyfluorinated alkyl segments is not sufficient to allow for prediction of properties and relevant interactions of all PFAS; other aspects of molecular structure must be considered. Plaintiff's description of "PFAS" includes substances with very different chemical and physical properties, and these differences affect if and how any particular PFAS may be used or encountered.

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orders of magnitude. (PFHpA: 0.229 mmHg vs PFHxS: 8.10×10^{-9} mmHg) Data available at https://comptox.epa.gov/dashboard/chemical_lists/pfasmaster. Accessed December 3, 2020.

[26] Data available at https://comptox.epa.gov/dashboard/chemical_lists/pfasmaster. Accessed December 3, 2020.

[27] Prediction models, such as those utilized by EPA in the CompTox Chemical Dashboard (https://comptox.epa.gov/dashboard), rely on the experimentally measured properties of structurally similar compounds to estimate certain physical and chemical properties. PFOA has the formula C7F15COOH, PFHxA has the formula C5F11COOH, and PFUnDA has the formula C10F21COOH. The lack of experimental data for the thousands of possible PFAS compounds creates limitations in models used to predict these chemical properties (Lampic, A. and Parnis, J.M. (2020) *Environmental Toxicology and Chemistry*. 39(4) 775-786.). Therefore, without clearly defining or describing specific PFAS, evaluating exposure using predicted chemical properties would rely on models that have insufficient underlying data to make these predictions. See also, for example, Cheng, W., & Ng, C. A. (2019). *Environmental Science & Technology*, 53(23), 13970-13980.

5. Differences in PFAS Properties Lead to Different Uses and How They May Be Encountered

PFAS are selected and used for different industrial and commercial applications based on their properties, which derive from their chemical structures. Fluorinated substances are used in myriad consumer products, medical devices and pharmaceutical products, textiles, food packaging products, industrial and manufacturing processes, and in many other ways. The reasons for their use are the particular combinations of functional characteristics that PFAS exhibit, including lubricity, water/oil/stain repellency, surfactant properties, oxygen solubility, chemical stability, high temperature stability, coatability, dimensional stability, film-forming capability, haemocompatibility, heat capacity, dielectric properties, and others.[28] Importantly, the desired characteristics obtained by using or incorporating a specific PFAS cannot be obtained from every other PFAS. In other words, individual PFAS are not interchangeable in a given product or application, and therefore will be encountered in different ways by different individuals.

Fluorinated substances are also found as mixtures and in various matrices in different products and applications. Importantly, the formulation of a product using a fluorinated substance can enhance or alter the variability associated with chemical diversity.

Because of diversity in PFAS chemistries and formulations associated with different uses, class members have the potential to encounter different PFAS in varying quantities based on their product use profile and other possible exposure routes. The availability of a specific PFAS for exposure may vary depending on factors such as the PFAS's method and level of use and mobility in an application, including the impact of a matrix, and the likelihood of decomposition and specific decomposition products that are generated. Exposure assessments are further complicated by additional considerations including solubility and transport in, and clearance

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[28] Glüge, J., Scheringer, M., Cousins, I. T., DeWitt, J. C., Goldenman, G., Herzke, D., ... & Wang, Z. (2020). *Environmental Science: Processes & Impacts*.

from, the human body.[29] When considering the nature and extent of exposure from an application, the full range of substances associated with that application, their availability, and how they might be represented in the body should be taken into account.

For example, Mr. Hardwick, the named Plaintiff, was a firefighter who claims to have been exposed to PFAS through products including firefighting aqueous film-forming foam (AFFF) and fire-resistant clothing. One or more PFAS in various combinations can be used for these two applications. Even if the same particular PFAS were used for both, the details of how it would be encountered would differ based on the physical characteristics of the compositions and the interactions of that PFAS within the compositions. Specifically, PFAS dispersed in aqueous media (such as firefighting foam) presents different mechanisms of exposure than the same PFAS molecules bound to a textile substrate (such as fire-resistant clothing). If we assume that this particular PFAS were to be present in Mr. Hardwick's blood serum, there is no method for determining from its mere presence if it came from one or both sources, or another source such as a different product or the degradation of different PFAS into this particular type. A detailed analysis of Mr. Hardwick's exposures would be necessary.

For other members of the proposed class, who were potentially exposed to PFAS in a multitude of different ways, such as through drinking water, the use of PFAS-coated products, through medical devices, or through other avenues, the variability in exposure type and magnitude is much greater. Differences in potential exposure are based on an individual's occupation, lifestyle, geography, and other factors. As a result, members of the class would have different sets of exposures that could not be determined in any class-wide way based on the presence, types, or amounts of PFAS in their blood. Any estimation of an individual's exposure or

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[29] The differences in chemical and physical properties between PFAS also result in different bioavailability and bioaccumulation characteristics. Materials properties that are relevant to exposure include the half-life of a substance in the body (Y. Xu, T. Fletcher, et al, *Environ. Health Perspectives*, **2020**, *128*, 077004 and, its degradation both in its intended application (Washington, J.W., J.J. Ellington, T.M. Jenkins, J.J. Evans, H. Yoo, S.C. Hafner, *Environ. Sci. Technol.*, **2009**, *43*, 6617-6623 (use-based degradation (Butt,C.M., D.C.G. Muir, S.A. Mabury, *Environmental Tox. And Chem.*, **2013**, *33*, 243-267)phase of matter (solid/liquid/gas), solubility/miscibility in different media, molecular size, and other.

identification of potential exposure sources must be informed by the context relevant to the individual.

6. The Network of Supply is Complex and Includes Entities Other than Defendants

Not all PFAS found in the United States are attributable to the Defendants. Several companies other than the named Defendants have "marketed, developed, distributed, sold, manufactured, released, trained users, produced instructional materials for, and/or otherwise handled and/or used one or more PFAS materials."[30] Indeed, the source and distribution of per- and polyfluorinated chemicals involves a global network of production, modification, and formulation that is broader than the named Defendants and has changed over time.

PFAS are manufactured and used by entities other than the named Defendants, including outside of the United States. Some PFAS, including PFOS and PFOA,[31] continue to be imported into the United States, either directly or as part of other compositions. Thus, at the raw material stage, not all PFAS are attributable to the Defendants. Although some PFAS are sold directly to consumers, PFAS are also distributed and sold to other companies for incorporation in or production of other substances and products. As a result, only some individuals encounter PFAS at this stage.

PFAS from any source may be used by numerous companies within the United States who make, use, and/or sell PFAS intermediates and products containing PFAS in various combinations and formulations. Examples include firefighting foams and textiles, which were allegedly encountered by Mr. Hardwick and are produced and sold by numerous companies that are not Defendants in this matter. Further, companies that produce, modify, and formulate using

[30] First Am. Compl., [ECF No. 96] at PageID #567, ¶ 29; Complaint, *In re Aqueous Film-Forming Foam Litigation*, MDL No. 2873 (Judge Richard Gergel).

[31] Zhang, L., Liu, J. , Hu, J., Liu, C., Guo, W., Wang, Q., & Wang, H. (2012) *Environmental Pollution 165*, 193-198; Tyco Fire Protection Products (2015) *Comments on proposed Significant New Use Rule for Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances* (Docket No. EPA-HO-OPPT-2013-0225). United States Environmental Protection Agency; Texas Instruments (2015) *Comments on proposed Significant New Use Rule for Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances* (Docket No. EPA-HO-OPPT-2013-0225). United States Environmental Protection Agency; Bloomberg News, May 22, 2020, *EPA Inspectors Focusing on Imports of PFAS, Other Chemicals*; OECD, 2015, Series on Risk Management No. 30, Working Towards a Global Emission Inventory of PFASS: Focus on PFCAs – Status Quo and the Way Forward.

PFAS may employ processes that chemically alter one PFAS to create new fluorinated substances that exhibit different properties than the original, based on a demand for differentiable properties that are prioritized based on specific applications. An example of this occurs in the production of some pharmaceuticals.[32] Thus, at the intermediate stage, not all PFAS are attributable to the Defendants, and only some individuals encounter PFAS at this stage.

Individuals and/or companies may handle and use products and formulations containing PFAS that are attributable to companies other than the Defendants in this matter. For example, fluorinated substances sourced from other companies are used as lubricants compatible with oxidizing gases, including oxygen for use in medical contexts.[33] The PFAS an individual encounters will change depending on their environment and product use profile. Thus, at the end-use stage, not all PFAS are attributable to the Defendants, and individuals encounter PFAS differently at this stage.

Because companies other than the Defendants participate in the network of supply at every level, the link between a particular PFAS in a particular product and its source is complex. Further, among the named Defendants, the type of involvement each Defendant has or has had with PFAS is not the same because the Defendants sit in different positions within the supply network, depending on the type of PFAS and time frame. They have manufactured/used different PFAS at different times and in different ways, in different volumes, and for different durations. Evaluating the specific exposure history of the individual, then, is the only reliable way to trace a particular PFAS measured in a blood test back to a source, manufacturer, or even to the named Defendants, because the named Defendants are not responsible for substantially all PFAS or PFAS-containing products that are or have been used in the United States.

[32] Wang, J., Sánchez-Roselló, M., Aceña, J. L., del Pozo, C., Sorochinsky, A. E., Fustero, S., Soloshonok, V.A. & Liu, H. (2014). *Chemical Reviews*, 114, 2432-2506.

[33] Rudnick, L. R. (Ed.). (2020). *Synthetics, mineral oils, and bio-based lubricants: chemistry and technology*. CRC press. Chapter 8.

7. Conclusion

In summary, the term "PFAS" applies to a great diversity of chemistries containing carbon-fluorine bonds that are manufactured, used, or sold by companies beyond the Defendants. These chemistries have myriad differences in their chemical and physical properties and these differences influence their availability for exposure. These differences also mean that PFAS are not interchangeable in the products and processes that might use them, and therefore when used, they are not likely to be present in amounts and proportions that are consistent across the products or processes. All of this interferes with the ability to identify the specific entity or entities that may have contributed any particular PFAS to a blood sample without considering how an individual may have encountered potential sources of PFAS.

This report summarizes work performed to-date and presents the findings resulting from that work. The findings and opinions presented herein are made to a reasonable degree of scientific and engineering certainty. The contents of this report are based on my review of documents in this case and publicly available literature, my education, and my experience. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available through ongoing discovery and/or through any additional work or review of additional work performed by others.

I declare under penalty of perjury that the foregoing is true and correct.

Maureen T.F. Reitman, Sc.D., December 14, 2020

APPENDIX A

Exponent®
Engineering & Scientific Consulting

Maureen T.F. Reitman, Sc.D., F.S.P.E., P.E.

Group Vice President and Principal Engineer
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Professional Profile

Dr. Reitman leverages her understanding of the fundamental principles of materials science and the technology of macromolecules to assess risk and performance for end users, distributors, manufacturers, product designers and raw material suppliers across a wide range of industries. Her expertise includes polymer and composite technology, mechanics of materials, adhesion science, fiber mechanics, history and technology of plastics, and material failure analysis. She is skilled in the development and use of testing tools and methods and has applied them to plastic, rubber, textile, metal, glass, ceramic, and composite materials and systems. She is experienced in major aspects of product development, including materials selection, formulation, scale-up, end-use testing, failure analysis, certification procedures and issues related to intellectual property.

Dr. Reitman has conducted research in the areas of medical plastics and devices including implants, diagnostic components, and transdermal drug delivery systems; plastic packaging and barrier materials; paints and coatings; plastic pipes; spray foam insulation; adhesives, sealants, and encapsulants; additive manufacturing / 3D printing; molding compounds; composite materials; high temperature resins; rubber gaskets and seals; nanoparticles; fibers and textiles; polymer chemical resistance; wire and cable insulation; connectors and splices; environmental effects on durability; and product aging. She has used her expertise to address problems and opportunities related to coatings, fibers, films, and extruded and molded products, and their use in the telecom, electronics, electrical, energy, transportation, construction, fire protection, medical, and consumer products markets. Dr. Reitman also assists clients with matters related to intellectual property, including support related to patent filings, technical due diligence, and technical aspects of trade secret, patent infringement, and patent validity disputes.

Dr. Reitman is active in technical and business advisory roles. She a member of the Board of Directors of the Medical Plastics Division and the Failure Analysis and Prevention Special Interest Group of the Society of Plastics Engineers as well as an active member of two Underwriters Laboratories Standard Technical Panels, addressing Polymeric Materials (UL 94, UL 746, UL 1694) and Appliance Wiring (UL758). Additionally, Dr. Reitman has served on technical advisory boards for materials and manufacturing companies.

Prior to joining Exponent, Dr. Reitman worked for the 3M Company in both research and management roles. Her activities included technology identification, materials selection and qualification, product development, customer support, program management, acquisition integration, staff and organizational development, intellectual property analysis, and patent litigation support.

Academic Credentials & Professional Honors

Sc.D., Materials Science and Engineering, Massachusetts Institute of Technology (MIT), 1993

B.S., Materials Science and Engineering, Massachusetts Institute of Technology (MIT), 1990

Fellow of the Society of Plastics Engineers

National Academy of Engineering Frontiers of Engineering, 2009

Tau Beta Pi

Sigma Xi

John Wulff Award

Carl Loeb Fellowship

NCAA Postgraduate Scholarship

Malcolm G. Kispert Award

GTE Academic All-American

Licenses and Certifications

Professional Mechanical Engineer, Maryland, #46268

Professional Affiliations

American Association for the Advancement of Science (member)

American Association of Textile Chemists and Colorists — AATCC (senior member)

American Chemical Society (member)

ASTM International (member)

Society for the Advancement of Material and Process Engineering (member)

Society of Plastics Engineers (Fellow)

Professional Appointments

Underwriter's Laboratory Standards Technical Panel STP 746 (Polymeric Materials, includes UL94, UL 746 and UL1694)

Underwriter's Laboratory Standards Technical Panel STP 758 (Appliance Wires/ UL758)

Medical Plastics Division Board of Directors, Society of Plastics Engineers

Failure Analysis and Prevention Special Interest Group Board of Directors, Society of Plastics Engineers

Patents

Patent 6,311,524: Accelerated Method for Increasing the Photosensitivity of a Glassy Material, issued November 6, 2001.

European Patent EP0830428: Tackified Polydiorganosiloxane Polyurea Segmented Copolymers and a Process for Making Same, published March 25, 1998.

Patent 5,731,051: Fiber Optic Fusion Splice Protector Sleeve, issued March 24, 1998.

Publications

Garcia-Leiner, M., Reitman, M. T.F., El-Hibri, M. J. and Roeder, R. K. (2016), Structure-property relationships in commercial polyetheretherketone resins. Polym Eng Sci. doi:10.1002/pen.24472

Farina, R., Reitman M. The effect of localized heating on polyethylene tubing. Proceedings, ANTEC 2015, Society of Plastic Engineers, Orlando, FL, March 2015.

Moalli P, Brown B, Reitman MTF, Nager C. Polypropylene mesh: Evidence for lack of carcinogenicity. International Urogynecology Journal 2014; 25(5):573-576.

Hoffman JM, Ralston B, Chakravartula A, Reitman M. ESC of polycarbonate exposed to hospital disinfectants. Proceedings, ANTEC 2013, Society of Plastic Engineers, Cincinnati, OH, April 2013.

Ralston B, Hoffman JM, Reitman M. Fractographic examination of failures in polycarbonate and polyxymethylene due to impact, tensile, fatigue, and creep mechanisms. Proceedings, ANTEC 2013, Society of Plastic Engineers, Cincinnati, OH, April 2013.

Kurtz S, Siskey R, Reitman M. Accelerated aging, natural aging, and small punch testing of gamma-air sterilized polycarbonate urethane acetabular components. Journal of Biomedical Materials Research Part B: Applied Biomaterials 2010 May; 93B(2):422-447.

Hoffman JM, Reitman M, Donthu S, Ledwith P. Complimentary failure analysis methods and their application to CPVC pipe. Proceedings, ANTEC 2010, Society of Plastics Engineers, Orlando, FL, May 2010.

Hoffman JM, Reitman M, Donthu S, Ledwith P, Wills D. Microscopic characterization of CPVC failure modes. Proceedings, ANTEC 2009, Society of Plastics Engineers, Chicago, IL, June 2009. Best Paper Award in Failure Analysis & Prevention.

Kurtz SM, Ebert M, Siskey R, Ciccarelli L, Reitman M, Harper ML, Chan FW. Natural and accelerated aging of polyurethanes in the Bryan cervical disc. Poster No. P158. Transactions of Spineweek 2008, Geneva, Switzerland, May 26-31, 2008.

Reitman M, Ledwith P, Hoffman M, Moalli J, Xu T. Environmentally driven changes in nylon. Proceedings, ANTEC 2008, Milwaukee, WI, Society of Plastics Engineers, May 2008.

Hoffman JM, Reitman M, Ledwith P. Characterization of manufacturing defects in medical balloons. Proceedings, ANTEC 2008, Milwaukee, WI, Society of Plastics Engineers, May 2008.

Moalli JE, Moore CD, Robertson C, Reitman MTF. Failure analysis of nitrile radiant heating tubing. Proceedings, ANTEC 2006, Society of Plastic Engineers, Charlotte, NC, May 2006.

Reitman M, McPeak J. Protective coatings for implantable medical devices. Proceedings, ANTEC 2005, Society of Plastic Engineers, Boston MA, May 2005.

McPeak J, Reitman M, Moalli J. Determination of in-service exposure temperature of thermoformed PVC via TMA. Proceedings, 31st Annual North American Thermal Analysis Society Conference, Williamsburg, VA, 2004.

Reitman MTF, Moalli JE. Product development and standards organizations: Listings and certifications for plastic products. 8th Annual International Conference on Industrial Engineering Theory, Applications and Practice, Las Vegas, NV, 2003.

Potdar YK, Reitman MTF. The role of engineering consultants in failure analysis and product development. 8th Annual International Conference on Industrial Engineering Theory, Applications and Practice, Las Vegas, NV, 2003.

Ezekoye OA, Lowman CD, Hulme-Lowe AG, Fahey MT. Polymer weld strength predictions using a thermal and polymer chain diffusion analysis. Polymer Engineering and Science 1998; 38(6):976-991, June.

Fahey MT. Nonlinear and anisotropic properties of high performance fibers. MIT Thesis, 1993.

Fahey MT. Mechanical property characterization and enhancement of rigid rod polymer fibers. MIT Thesis, 1990.

Book Contributions

Reitman, M., Dimitriou, M., Vargas, J., Madden, S. Why is service life prediction of polymers and plastics exposed to outdoor weathering important? An industrial perspective. In Plastics Design Library, Service Life Prediction of Polymers and Coatings, White, C., Nichols, M., and Pickett, J. (eds.), Elsevier, 2020. ISBN 978-0-12-818367-0.

Reitman M, Jaekel D, Siskey R, Kurtz S. Morphology and crystalline architecture of polyarylketones, In: PEEK Biomaterials Handbook, Second Edition. Kurtz SM (ed), Elsevier William Andrews, Kidlington, Oxford, UK, 2019. ISBN 978-0-12-812524-3

Reitman M, Liu D, Rehkopf J. Chapter 38. Mechanical properties of polymers. In: Handbook of Measurement in Science and Engineering. Volume 2. Kutz, M (ed), John Wiley & Sons, Hoboken NJ, 2013. ISBN- 978-1-118-38464-0.

Reitman M, Jaekel D, Siskey R, Kurtz S. Morphology and crystalline architecture of polyarylketones, pp. 49-60. In: PEEK Biomaterials Handbook. Kurtz SM (ed), Elsevier William Andrews, Kidlington, Oxford, UK, 2012. ISBN 13:978-1-4377-4463-7

Tsuji JS, Mowat FS, Donthu S, Reitman M. Application of toxicology studies in assessing the health risks of nanomaterials in consumer products, pp. 543-580. In: Nanotoxicity: From In Vivo and In Vitro Models to Health Risks. Sahu S, and Casciano D. (eds), John Wiley & Sons, Chicester, West Sussex, UK, 2009. ISBN 978-0-470-74137-5.

Reitman MTF. The Plastics Revolution. In: Research and Discovery: Landmarks and Pioneers in American Science. Lawson RM (ed), Armonk NY: Sharpe Reference 2008. ISBN 978-0-7656-8073-0.

Klein SM. Mid-century plastic jewelry. Schiffer Publishing, Atglen, PA, 2005. (Technical advisor to author).

Trade Articles

Comerford PJ, Reitman MTF, Cooner, DJ. The legal issues of the 3DP/AM revolution. RX for the Defense 2014 Jan; 22(1).

Comerford PJ, Vernon DV, Reitman, MTF. 3DP/AM revolution is also a legal revolution. (http://www.manufacturing.net/articles/) December 2013.

Comerford, PJ and Reitman, MTF. The 3DP/ AM revolution . Today's Medical Developments (cover story) (www.onlinetmd.com), October 2013.

Reitman, MTF, Moalli JE. Polymeric coatings for medical device. Medical Device and Manufacturing Technology, Touch Briefings 2006; pp. 28-30.

Selected Invited Presentations

Reitman, M. Improving Outcomes for Patients and Societies. Keynote Speaker, Medical Plastics Minitec, Society of Plastic Engineers, Anaheim, CA February 2020.

Wade, RJ, Kiel J, Reitman M TF. Oxidative stability of polypropylene for biomedical applications. 257th American Chemical Society Meeting. Orlando April 2019.

Reitman MTF. Service Life and Practical Risk: Incorporating failure modes and predictive tools in product development. NIST/ UL Conference on Service Life Prediction of Polymeric Materials: Reaching New Heights. Boulder, CO March 2018.

Reitman MTF. Innovate from what you know: Tips and tricks for medical device development. Teel Medical Plastics Summit, Minneapolis MN, November 2017.

Reitman MTF. Characteristics and Stability of Implantable Polypropylene Fibers. Medical Plastics Minitec, Society of Plastics Engineers, Durham, NC, April 2016.

Reitman MTF. 3D Printing technology viewed from the inside: Recognizing opportunity and managing risk. Presenter and panelist, Product Liability Advisory Council Spring Meeting, Miami, FL, March 2016.

Reitman MTF. To Your Health: Polymers in Biology and Medicine. Medical Plastics Keynote. ANTEC 2015 Conference, Orlando, FL, March 2015.

Reitman MTF. Turning failure into success: tools, techniques and practical examples for product development engineer. ANTEC FAPSIG Tutorial, Las Vegas, NV, April 2014.

Reitman MTF. Materials science of surgical meshes: Polypropylene for soft tissue repair. AATCC International Conference, Materials Track-Medical Textiles, Ashville, NC, April 2014.

Reitman MTF. PEEK: A structure-property-performance overview for medical device designers. AAOS/Solvay Education Summit: Healthcare Industry Perspective to Support Innovation and Product Development in a Challenging Global Environment, New Orleans, LA, March 2014.

Reitman MTF. Assessment of proposed division by type for F2026 in light of material, manufacturing and testing variability. ASTM F04 Committee meeting, Jacksonville, FL, November 2013.

Reitman MTF. Materials science of surgical meshes: Polypropylene for soft tissue repair. American Urogynecology Society (AUGS) 34th Annual Scientific Meeting, Mesh Special Interest Group, Las Vegas, NV October 16, 2013.

Reitman MTF. Structure-property overview of medical polymers. 4th China International Medical Device Regulatory Forum (CIMDR), Xi'an, China, September 2013.

Reitman MTF. Failure analysis of polymeric materials in medical applications: Lessons for successful material selection. Polymers and Plastics in Medical Devices San Francisco, CA, June 2013.

Reitman MTF. Failure analysis tools. Workshop on Future Needs for Service Life Prediction of Polymeric Materials. NIST and Underwriters Laboratories, Gaithersburg, MD, October 2012.

Hoffman J, MacLean S, Ralston B, Reitman M, Ledwith P. Fractography of unfilled thermoplastic materials experiencing common mechanical failure modes. Materials Science & Technology 2012

Conference, Pittsburgh PA, October 2012.

Hoffman J, Reitman M, Ledwith P. Microscopic characterization of CPVC failure. Materials Science & Technology 2012 Conference, Pittsburgh PA, October 2012.

Reitman MTF. Polymer material properties for next generation medical devices. Invited Speaker: MedTech Polymers, UBM Canon, Chicago, IL, September 2012.

Reitman MTF. Polymers for medical applications. Fundamentals and Fellows Forum, ANTEC 2012, Orlando FL, April 2012.

Reitman MTF. Plastic and composite product failures. Invited lecture in Failure Analysis of Emerging Technologies. Stanford University Department of Materials Science and Engineering, Menlo Park, CA October 2009.

Reitman MTF. Factors for success: Plastics in injection molded medical devices. Part of Injection Molding Works for Medical Design, Design News Webcast, October 2008.

Reitman MTF. Plastic and composite product failures. Keynote Speaker: Third International Conference on Engineering Failure Analysis (ICEFA III), Elsevier, Sitges Spain, July 2008.

Reitman MTF. Multiphase materials for medical device applications, an overview. Medical Device and Manufacturing (MDM), Canon Communications, various locations, Jan-June 2008.

Reitman MTF. Nanotechnology and plastics for medical devices. Capitalizing on Nanoplastics, Intertek PIRA San Antonio TX, February 2008.

Reitman MTF. Nano additives in composites and coatings for medical device applications. Medical Device and Manufacturing Minneapolis, Canon Communications, Minneapolis MN, October 2007.

Reitman MTF, Swanger LA. Practical tips on how to manage your technical expert in patent disputes. Ropes & Gray IP Master Class, Live Teleconference, June 2007.

Reitman MTF, Kennedy E. Root cause failure analysis and accident investigation. Lorman Educational Services, Live Teleconference, November 2007.

Reitman MTF. Plastics failure analysis: Case studies. Baltimore/ Washington Chapter of SAMPE, October 2006.

Reitman MTF. Plastics failure analysis. Baxter Global Plastics Processing Conference 2005, Schaumburg IL, 2005.

Fahey MT. Fiber mechanics, corrosion, sealants: Tales of a 3M materials scientist. Class of 1960's Scholars Program, Williams College, 1999.

Fahey MT. Adhesives and sealants for the telecommunications industry. Riverwood V Conference, St. Paul MN, 1998.

Advisory Appointments

UL Forum on Initiatives to Improve the Long Term Aging Program, LTTA Tools Working Groups, Underwriters Laboratories

Teel Manufacturing Technical Advisory Board

Solvay Advanced Materials Health Care Advisory Board

Peer Reviewer

Reviewer, Medical Plastics Technical Program Committee, Society of Plastics Engineers

Reviewer, Failure Analysis and Prevention Technical Program Committee, Society of Plastics Engineers

Reviewer, various book proposals and submissions related to polymer science, ASM International, Elsevier, John Wiley, Hanser, NIST

APPENDIX B

<u>Testimony List of Maureen Reitman, Sc.D., P.E. (Last Four Years)</u>

Zylon Corp. and Alan Zamore v **Medtronic, Inc**., Medtronic Vascular, Inc., and Medtronic Vascular Holdings, Ltd., f/k/a Ave Galway, Ltd. (Supreme Court of the State of New York) January 2017 (Trial)

The Estate of James Wurster, by Judith Wurster, its administrator, and Judith Wurster, individually v. **The Plastics Group, Inc.**, et al. (United States District Court Southern District of Iowa Central Division) April 2017 (Trial)

Taylor Ferguson and Elyse Stanton v **Wal-Mart Stores, Inc., Wal-Mart Stores East, LP, and Wal-Mart Stores Arkansas, LLC** (Circuit Court of Sebastian County, Arkansas Civil Division) May 2017 (Deposition)

Naturalock Solutions, LLC v **Baxter Healthcare Corporation, a Delaware corporation, Baxter International, Inc., and Baxter Healthcare S.A**. (United States District Court for the Northern District of Illinois) May 2017 (Deposition)

In Re: **C.R. Bard, Inc.** Pelvic Mesh/Bard Litigation (Superior Court of New Jersey Law Division – Bergen County; Case No. 292; McGinnis, Rios) June 2017 (Deposition)

United States International Trade Commission: In the Matter of Certain Basketball Backboard Components and Products Containing the Same. (Retained on behalf of **Russell Brands, LLC**.) June 2017 (Deposition)

Velma Searcy v 3M Company, et al. (Los Angeles Superior Court). September 2017 (Deposition) October 2017 (Trial) (Retained on behalf of **Henkel Corporation and Dexter Hysol Aerospace LLC**)

Ansell Healthcare Products LLC v Reckitt Benckiser LLC (United States District Court for the District of Delaware) September 2017 (Deposition)

Kerry P. Becker v. C.R. Bard, Inc and Davol, Inc. In Re: **C. R. Bard, Inc**. Composix Kugel Mesh Hernia Patch Products Litigation (Superior Court, State of Rhode Island) October 2017 (Deposition)

Metalcraft of Mayville, Inc. v Flambeau, Inc. (Circuit Court of Dodge County, State of Wisconsin) October, November 2017 (Deposition) February 2020 (Trial)

DSM Dyneema, LLC v Thames Thagard, Ph.D., **Honeywell Specialty Materials, LLC, Honeywell Advanced Composites, Inc., and Honeywell International Inc.** (Superior Court Division, State of North Carolina) November 2017 (Deposition)

William Stemmler, et al. v **MTD Products, Inc.** et al. (Supreme Court of the State of New York Case No. 700029/2007) February 2018 (Trial)

Flowcrete North America, Inc. v Verdia, Inc., Anthony Crowell, David Keller, Ann Delve, and Sheryl Kunning. (District Court of Montgomery County, TX, 410th Judicial Court) March 2018 (Deposition)

A. Schulman, Inc. et al. v **Citadel Plastics Holdings, LLC et al.** v Robert J. Brinkmann. (Court of Chancery of the State of Delaware) April 2018 (Deposition) (Retained on behalf of **HGGC and Charlesbank.)**

Sonoma Pharmaceuticals, Inc. v Collidion, Inc. et al. (United States District Court Northern District of California San Francisco Division) April 2018 (Deposition)

Chemtall Incorporated v **BASF SE and BASF Corp.** (United States District Court Southern District of Georgia Savannah Division) July 2018 (Deposition)

City of Wyoming, MN et al. v Proctor & Gamble Company et al. (United States District Court for the District of Minnesota) September 2018 (Deposition) (Retained on behalf of **Rockline Industries, Inc.)**

Louisiana-Pacific Corporation and Louisiana-Pacific Canada, Ltd. V Akzo Nobel Coatings, Inc., Akzo Nobel Coatings, Ltd. Et al. (In the General Court of Justice Superior Court Division, Wilkes County, North Carolina) September 2018 (Deposition Part I and Part II) October 2019 (Deposition) July 2020 (Deposition)

United States International Trade Commission. *In the Matter of Certain Blow-Molded Bag-In Container Devices, Associated Components, and End Products Containing or Using Same.* (Retained on behalf of **Heineken N.V., Heineken International B.V., and Heineken USA**) December 2018 (Deposition)

Dream Finders Homes, LLC and DFH Mandarin LLC v **Weyerhaeuser NR Company**. (District Court, County of Denver, State of Colorado) July 2019 (Deposition) September 2019 (Trial)

San Diego Unified Port District and City of San Diego v **Monsanto Company, Solutia Inc. and Pharmacia Corporation.** (United States District Court, Southern District of California) July 2019 (Deposition)

Petrolina Gonzalez v **Nutribullet LLC**. (Superior Court of the State of California for the County of Los Angeles-Central District) August 2019 (Deposition)

Integrated Laminate Systems, Inc. v **Wilsonart, LLC et al.** (Superior Court of New Jersey Law Division Camden County) August 2019 (Deposition) October 3, 2019 (Deposition) October 28, 2019 (Deposition)

Coordinated Proceedings Special Title (Rule 3.550(b)). Essure Product Cases: All Cases. (Superior Court of the State of California, County of Alameda) Judicial Council Coordination Proceeding No. 4887. November 2019 (Deposition). (Retained on behalf of **Bayer Corporation, Bayer Healthcare, LLC, Bayer Essure, Inc. (formerly known as Conceptus Inc.), and Bayer HealthCare Pharmaceuticals.**)

In Re: Davol/C.R. Bard Hernia Mesh Multi-Case Management. (Superior Court of the State of Rhode Island, Providence) December 2019 (Depositions in the matters of Hrenko, Zukowski-Schmidt, and Rudd.). (**Retained on behalf of Davol, Inc., C.R. Bard, and Becton, Dickinson and Company)**

In Re: Davol, Inc./C.R. Bard, Inc., Polypropylene Hernia Mesh Devices Liability Litigation (United States District Court Southern District of Ohio Eastern Division) February 2020 (Depositions in the matters of Campos, Johns, McCourt, Milanesi, Miller, and Stinson)**. (Retained on behalf of Davol, Inc., C.R. Bard., and Becton, Dickinson and Company**).

In Re: Boston Scientific Corp. Pelvic Repair System Products Liability Litigation (United States District Court Southern District of West Virginia Charleston Division) March 2020 (Deposition in the matter of Katrina Hinnewinkel v Boston Scientific Corp. et al.) **(Retained on behalf of C.R. Bard)**.

Eugene Ruddy and Rebecca Ruddy, husband and wife, individually and as parents of Scott Ruddy, a minor v **Polaris Industries, Inc. and Polaris Sales, Inc.** (United States District Court for the Middle District of Pennsylvania) June 2020 (Deposition)

Mark Terek, Individually and as Personal Representative of The Estate of Theodore R. Terek, Deceased; Tricia Marie Kursel and Kim Marie Terek v **BASF Corporation.** (State of Wisconsin Circuit Court) July 2020 (Deposition)

King County v **Viracon, Inc.**, Quanex I.G. Systems, Inc., Truseal Technologies, Inc., and Does 1-100. (United States District Court Western District of Washington at Seattle) August 2020 (Deposition).

United States International Trade Commission. *In the Matter of Certain Synthetic Roofing Underlayment Products and Components Thereof.* (Retained on behalf of **CertainTeed Corporation, GAF Materials LLC, DuPont de Nemours, Inc., E.I. Du Pont de Nemours and Company, Owens Corning/Owens Corning Roofing and Asphalt LLC, Interwrap, Inc., Epilay, Inc., and Atlas Roofing Corporation.**) December 2020 (Deposition).

Exponent charges $750 per hour for Dr. Reitman’s consulting services in 2020. No part of Exponent’s compensation is contingent on the outcome of this matter.

APPENDIX C

Materials Considered

Case Documents

First Amended Complaint, filed 04/16/2019, Doc. 96.

Plaintiff's Motion for Class Certification, filed 7/31/20, Doc. 164.

Additional Exhibits in Support of Plaintiff's Motion for Class Certification, filed 7/31/20, Doc. 165.

KH_000014

Hardwick Deposition 10/23/20, Transcript and Exhibits

Subpoena Production, NMS Lab

Other Publicly Available Materials

Alsmeyer, Y. W., Childs, W. V., Flynn, R. M., Moore, G., Smeltzer, J. C. (1994) Electrochemical fluorination and its applications. In Banks, R. E., Smart, B. E., & Tatlow, J. C., Eds.; *Organofluorine Chemistry* (pp. 121–144) Plenum Press.

Bentel, M.J., Yu, Y., Xu, L., Kwon, H., Li, Z., Wong, B.M., Men, Y., Liu, J., (2020), *Environ. Sci. Technol. 54*(4), 2489-2499

Bloomberg News, May 22, 2020, *EPA Inspectors Focusing on Imports of PFAS, Other Chemicals*.

Buck, R.C., Franklin, J., Berger, U., Conder, J.M., Cousins, I.T., de Voogt, P., Jensen, A.A., Kannan, K., Mabury, S.A., & van Leeuwen, S.P.J. (2011) *Int. Env. Assess. and Management*, *7*(4), 513-541

Butt, C.M., D.C.G. Muir, S.A. Mabury, *Environmental Tox. And Chem.*, **2013**, *33,* 243-267

Cheng, W., & Ng, C. A. (2019). *Environmental Science & Technology*, 53(23), 13970-13980.

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Glüge, J., Scheringer, M., Cousins, I. T., DeWitt, J. C., Goldenman, G., Herzke, D., ... & Wang, Z. (2020). *Environmental Science: Processes & Impacts*.

Henry, B.J., Carlin, J.P., Hammerschmidt, J.A., Buck, R.C., Buxton, L.W., Fiedler, H., Seed, J., & Hernandez, O. (2018) *Int. Env. Assess. and Management*, *14*(3), 316-334

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International Regulatory Technology Council "PFAS - Per- and Polyfluoroalkyl Substances." *PFAS Chemistry, Terminology, and Acronyms*, Sept. 2020, pfas-1.itrcweb.org/2-2-chemistry-terminology-and-acronyms/. Accessed November 16, 2020.

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Organization for Economic Cooperation and Development. Environment Directorate. (2018) *Toward a New Comprehensive Global Database of Per- and Polyfluoroalkyl Substances (PFASs): Summary Report on Updating the OECD 2007 List of Per- and Polyfluoroalkyl Substances (PFASs)* (Series on Risk Management, No. 39).

Organization for Economic Cooperation and Development. Environment Directorate. (2020) *Comprehensive Global Database of PFASs*, http://www.oecd.org/chemicalsafety/risk-management/global-database-of-per-and-polyfluoroalkyl-substances.xlsx, Accessed December 8, 2020.

Rao, N.S., & Baker, B.E. (1994) Textile Finishes and Fluorosurfactants. In Banks, R. E., Smart, B. E., & Tatlow, J. C., Eds.; *Organofluorine Chemistry* (pp. 321–338). Plenum Press

Rudnick, L. R. (Ed.). (2020). *Synthetics, mineral oils, and bio-based lubricants: chemistry and technology*. CRC press. Chapter 8.

Smart, B.E. (1994) Characteristics of C-F Systems. In Banks, R. E., Smart, B. E., & Tatlow, J. C., Eds.; *Organofluorine Chemistry* (pp. 57–88). Plenum Press.

Texas Instruments (2015) *Comments on proposed Significant New Use Rule for Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances* (Docket No. EPA-HO-OPPT-2013-0225). United States Environmental Protection Agency.

Tyco Fire Protection Products (2015) *Comments on proposed Significant New Use Rule for Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances* (Docket No. EPA-HO-OPPT-2013-0225). United States Environmental Protection Agency.

U.S. Agency for Toxic Substances & Disease Registry, "Toxic Substances Portal: Perfluoroalkyls", https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=237, Accessed December 8, 2020

U.S. CDC, (2018) "National Health and Nutrition Examination Survey: Perfluoroalkyl and Polyfluoroalkyl Substances", https://wwwn.cdc.gov/Nchs/Nhanes/2017-2018/PFAS_J.htm, Accessed December 8, 2020

U.S. Environmental Protection Agency (2002) *Perfluoroalkyl Sulfonates; Significant New Use Rule; Final Rule and Supplemental Proposed Rule* (40 CFR Part 721, Vol. 67, No. 47, pp. 11008-11013).

U.S. Environmental Protection Agency (2020) *Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances; Significant New Use Rule* (40 CFR Part 721, Vol. 85, No. 144, pp. 45109-45126)

U.S. EPA, (2020) "PFAS Master List of PFAS Substances (Version 2)", https://comptox.epa.gov/dashboard/chemical_lists/pfasmaster, Accessed December 9, 2020

U.S. FDA "Inventory of Effective Food Contact Surfaces (FCS) Notifications", https://www.cfsanappsexternal.fda.gov/scripts/fdcc/index.cfm?set=FCN, Accessed December 8, 2020.

Wang, J., Sánchez-Roselló, M., Aceña, J. L., del Pozo, C., Sorochinsky, A. E., Fustero, S., Soloshonok, V.A. & Liu, H. (2014). *Chemical Reviews*, 114, 2432-2506.

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